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CONCERNING L. A. VITEL'S' ARTICLE "GROUP CHARACTERISTICS OF ANALOGS"

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For the present, long-range weather forecasts are based on quantitative methods; therefore, the use of analogs as an auxiliary tool in forecasting is unavoidable. This necessity is also dictated by the fact that with a qualitative method, the forecaster has no right to forecast phenomena which have not been previously observed in nature. The Mul'tanovskiy method of long-range weather forecasting is not the method of analogs, as is assumed by many, although the analog finally selected is used in drawing up the forecast.

At the same time, long-range synoptic meteorologists do not consider analogous processes as something indefinite, as was stated in L. A. Vitel's article "Method of Selecting Analogs in Long-Range Weather Forecasts," Meteorologiya i Gidrologiya, No 3, 1948. Vitel's must have known that a definition of analogousness was formulated back in 1939 by S. T. Pagava, in "A Method for Calculating the Intensity of Intrusion of Cold-Air Masses in Circulation Mechanisms as Expected from the Periods (Rhythms)" Trudy Glavnaya Geofizicheskaya Observatoriya, No 27, 1939. According to this definition, circulation mechanisms were considered analogous if the same operative centers and, consequently, the same phases, functioned in a natural synoptic region. In other words, the circulation mechanisms were considered analogous if the geographical distribution of tropospheric deformation fields and, the orientation of the main pressure formations were identical.

In attempting to provide a basis for his method of selecting analogs, L. A. Vitel's, in his articles "Method of Selecting Analogs in Long-Range Weather Forecasts" and "Group Characteristics of Analogs" Meteorologiya i Gidrologiya, No 4, 1948, gave a distorted and biased picture of the method used in the Division of Long-Range Forecasts, Central Forecasting Institute.

Without discussing the details of the method, we will consider the main difference between the existing methods of selecting analogs and the method proposed by Vitel's.

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The large-scale processes which determine the weather characteristics of a month or season do not emerge and disappear suddenly. Within a synoptic process restricted by natural limits, the future process is generated and prepared. This, at first glance, creates the false impression that development of synoptic processes in the future will be similar after similar synoptic states in analog years.

However, the experience of any long-range synoptic meteorologist, or archives material, shows that the dependence between the current synotic process and the future one for various analog years can almost never be unambiguous. This relationship is much more many-sided than is desirable for the forecaster. Uniquely developing processes in the past give no guarantee that the processes developing in the future will be just as unique. In addition, it is well known that indentical repetition is generally not observed in nature. Because of this, it is necessary to set a boundary between analogs selected for current processes and analogs which will retain similarity in the future.

The problem of selecting analogs for the synoptic process is solved by comparing it with synoptic processes observed in the past.

The method of evaluating analogousness of the synoptic process is of only second-rate importance at best, since high evaluation of analogousness for the current period, no matter how expressed, is still no guarantee of the analogous development of synoptic processes in the future even for synoptic processes which are homogeneous in structure, such as the natural synoptic period and season. This applies even more so to arbitrarily isolated processes which do not have homogeneous structure.

Consequently, we must have additional criteria to select from a group of analogs for a current synoptic process those (or that one) which will subsequently develop analogously. In the method of long-range forecasts used in the Central Forecasting Institute, these additional criteria are datum-point ultrapolar axes.

The rules worked out for rhythmic activity in the atmosphere make it possible to expect established synoptic processes in the future at previously determined times due to a disturbance of zonal atmospheric circulation, i.e., datum-point ultrapolar effects, in the recent past (3 to 5 months). The correlation coefficient for these rules of rhythmic activity in the atmosphere is 0.92. Thus, the analog selected must satisfy, in addition to analogousness in the past, definite characteristics in the future established from well-founded rules of rhythmic activity in the atmosphere. These rules make it possible to change over from a simple unbased extrapolation of synoptic processes to their interpolation between a whole series of characteristic states definitely orientated in time and space. These characteristic states are both current synoptic processes and those processes expected from rhythms.

The presence or absence of these characteristics in analog years determines their potentialities. The presence of all these characteristics in even a relatively poor historical analog signifies retention and intensification of analogousness in the future; but complete or partial absence of them in the very best historical analog signifies cessation of similar development of atmospheric processes and effects in the future. Therefore, even a very good analog with respect to past history cannot be accepted for forecasting purposes if the necessary future characteristics are not present in it. If these characteristics are mostly present in another analog year, even if it is not such a good analog with respect to history, this is sufficient reason to select it for forecasting. Thus, it follows that Vitel's not only underevaluated the difference between the extrapolation accepted by him in his work and interpolation of the synoptic processes, but even attempted to replace the latter by the former. This return to extrapolation would be a considerable step backwards, even in comparison with the level reached by the synoptic meteorologists of the Mul'tanovskiy school in the first years of its existence.

Recently, synoptic meteorologists of the Central Forecasting Institute have been trying to become even less dependent on history in the selection of analogs. The new method devised in the Central Forecasting Institute has also solved this particular problem.

The regularities revealed in the development of synoptic processes make it possible to establish the characteristics of the future natural synoptic period or season when the current synoptic process (period or season) has just begun to develop.

These regularities also have a correlation coefficient varying from 0.75 to 0.93, depending on the structure of the deformation fields of the period or season.

In the first years of the Mul'tanovskiy school, a similar development of processes in past history was considered a necessary condition in the selection of analogs for both periods and seasons. The regularities in the development of synoptic processes revealed in the Central Forecasting Institute made it possible to reject this requirement. According to the new method of long-range weather forecasting for a relatively short time in advance, the analog selected must be similar in development to the current natural synoptic period and must have, in the following period, those characteristics of the tendency of the current period about which indications were obtained from the analysis of the tropospheric temperature-pressure field. Analogousness in the preceding natural synoptic period is not absolutely compulsory. The same thing applies to analogs for the natural synoptic season. The analog searched for must satisfy those characteristics about which indications were obtained from the analysis of regularities of the vertical temperature-pressure field of the current natural synoptic season. As a result, those analogs are selected which, in the future, will exhibit a definite transition to the already established characteristics of the natural synoptic period or season.

Briefly, these are the principles of the method of analog selection used in the Central Forecasting Institute.

It is seen from the above that there is no "weigh," "balance," and "make-weight" such as Vitel's spoke of in his articles. It is also clear that formal extrapolation into the future, of processes which have developed quite analogously in the past, is not and cannot be a methodological basis for selecting analogs... Thee method of selecting analgos used in the Central Forecasting Institute is based not on formal extrapolation but on the studies of the interconnection of atmospheric processes in nature, and the regularities found in this interconnection have a high statistical correlation.

By virtue of this method, the analog finally selected makes it possible to forecast not only the mean characteristics expected of the season (which in no way satisfies the demands of the consumer and would be a step backward) but also the behavior of the weather phenomena which form these mean characteristics as well as extremal phenomena in nature (which the economy especially needs).

In regard to an intelligent limit for the use of analogs, it is quite definately determined by the limits within which homogeneity of the circulation mechanism is maintained, the nature of which is established from studies of the laws of development of current processes. In practice, these limits do not exceed one or two natural synoptic seasons.

Since we can forecast the shift of natural synoptic periods within a synoptic season, we have the right to forecast the time behavior of meteorological characteristics in space. These potentialities determine the degree of "detailization" of long-range weather forecasts.

Let us now consider the method which Vitel's proposes to replace the "worthless," in his opinion, method of analog selection used in the Central Forecasting Institute.

First of all, we must clarify what the author himself understands by analogs in his paper "Method of Selecting Analogs in Long-Range Weather Forecasts."

After devoting almost half his paper to proving that "only a clear and completely distinct definition" of the concept of analogs can eliminate subjectivity in evaluating analogousness, Vitel's does not give any clear definition of this concept. The author also blames the Central Forecasting Institute, quite without basis, for "metaphysically contrasting analogs and non-analogs," using quotes from Engels' Dialectics of Nature. The instructions of the Central Forecasting Institute, however, do not provide for such "absolute contrast." Vitel's himself, in the paper "Group Characteristics of Analogs," metaphysically contrasts them by dividing years into group analogs and counteranalogs. It is our belief that the use of quotations from Dialectics of Nature does not free the author from the responsibility of using a dialectical method in his personal research. Therefore, even "an evaluation of analogousness from the standpoint of characteristics expressed by number" cannot justify such an unprincipled presentation of the problem.

What are these numerical expressions?

Having adopted the principle of evaluating analogousness from the magnitude of the deviation of the given characteristic in the analog from its value in the comparison year, Vitel's obtained a number of numerical values, i.e., the ratio of this deviation to the perennial amplitude of the given characteristic, expressed in percent. In his opinion, these quantities objectivized the method of selecting analogs.

Of what does this objectivity consist?

In evaluating analogousness with respect to several characteristics, as is usually the case, the values obtained for each characteristic separately (D) or 100% minus these values (A) must be averaged for each region of the catalog, first with respect to the entire natural region, and then these latter for all characteristics.

The author asserts that the result obtained is an "objective" numerical evaluation of the analogousness of the given year with the comparison year. Let us assume that we have established the analogousness averaged for the entire synoptic region for each characteristic separately for several characteristics: (1) pressure-circulation regime, (2) mean temperatures, (3) precipitation anomalies, etc.

It is easy to imagine a case where the degree of analogousness for the characteristics selected in the year B could be arranged in descending order from 100% for the first characteristic to 50% for the last. In the year C, on the other hand, they could be arranged in increasing order through the same intervals from 50% for the first characteristic to 100% for the last. According to the proposed method, the degree of analogousness with respect to all characteristics would have to be averaged for each year to decide which of the analogs was best. Since the items of the sum would not be changed in the permutation, the mean value for both years would be identical. Which of these two analogs would be considered best in this case? They both cannot be best. If, in the first year, for example, analogousness with respect to the pressure-circulation regime was 100%, it was 50% in the second year; the reverse holds for the last characteristic in the series. Finally, how can both analogs be better than a third (E) in which analogousness can be arranged neither in a descending nor ascending order, but has values close to the average of but slightly less than the first two? We note that all these quantities are related for the meantime only to analogousness in history.

The proposed method does not answer this question. The difficulty springs from the lack of weights for each characteristic. Introduction and foundation for such weights is impossible in the method of analog selection proposed. Therefore, the only outlet for the author was the subsequent "perfection" of the method, which was discussed in the article "Group Characteristics of Analogs." Thus, Vitel's considered the second main distinction of the proposed method to be the transition "from the individual properties of one (even the best) analog to the consideration of group characteristics to eliminate the individual characteristics of the separate analogs and search for something general characterizing all good analogs or most of them."

Thus, instead of exposing those characteristics which may appear as a result of the uniquely developing current processes, averaging of the general features for the selected group of years is proposed both for analysis of current process and for obtaining of mean characteristics following the current macroprocesses. This is very close to the concept of averages, the most frequently repeated values. The task of long-range forecasting is to predict not the average, but something special that results from a concrete situation even if that which is forecast is observed but once in 50 years.

Without regard to the degree of analogousness, or the method of expressing this analogousness, Vitel's concept of a "good analog" belongs to a past situation. As we have already noted, however, history itself testifies to the fact that well-defined analogousness in the past is not always a guarantee of its preservation in the future. What guarantee is there that a group analog with a degree of analogousness, even of common characteristics, of 95% will give 90%, 80% or 50% analogousness in the future?

Vitel's does not give such a guarantee, although in his article he quite frequently emphasizes the necessity for high correlation coefficients in long-range forecasting. Without this guarantee, we cannot submit the forecaster to the arbitrariness discussed in Vitel's' works.

Unfortunately, there are no concrete examples of group analogs and the principle of their classification in Vitel's works. However, we can get some idea of these from a number of Vitel's' published works and manuscripts.

Vitel's emphasizes that the group characteristics of analogs can best be constructed by comparison of all composite maps which reflect the characteristics of the entire group of analogs.

We can learn the structure of group characteristics which are constructed by classification of synoptic processes based on the catalog from a work by the same author, "Seasonal Types of Synoptic States," in Problems of the Method of Long-Range Forecasts, Gidrometeoizdat, Leningrad, 1946. Table 9 of that work gives the structure of anomalously warm (1917, 1929, 1931) and anomalously cold (1906, 1910, 1925) winter seasons. It gives data characterizing the frequency of the seasonal types isolated by the author in the group of cold and warm winters.

Thus, according to the example, the average frequency of summer processes in the group of cold winters (16%) differs from the average frequency in the group of warm winters (12%) only by 4%, i.e., is less in the latter. The frequency of winter types in the group of cold winters (35%) is 20% less than the frequency of these types in the group of warm winters (55%). The frequency of fall types is equal (22%) in both groups. Thus, from the classification proposed, it follows that the difference between warm and cold winters is determined not by the predominance of winter processes in them, as is actually observed, but by the predominance of spring types. The average frequency of spring types was only 28% in the cold-winter group and 11% in the warm-winter group.

From this alone it is clear that the names of the various types do not correspond to their actual content, since 35% winter types are of less importance for determining a cold winter season than 28% spring types. Why the spring type is called basic for spring is also not clear, since their maximum frequency in the group of warm springs (ibid., Table 12) is only 25%.

Exactly the same thing is obtained from Table 15, in the above-mentioned work, which gives the structure of anomalously warm (1901, 1920, 1927) and cold (1904, 1918, and 1928) summer seasons. This table shows that the types isolated for groups of warm and cold summer seasons in no way confirm the division adopted.

Actually, the mean frequency of spring types is identical for warm and cold seasons and is equal to 16%. The frequency of summer types differs by only 5%, i.e., it is 51% in the group of cold summers and 56% in the group of warm summers. This same thing is observed for frequency of fall types, which is 13% in the group of cold seasons and 15% in the group of warm seasons. What is the value of such types united into group analogs if their frequency in opposite seasons is identical? Besides, Vitel's himself on page 149 of "Seasonal Types of Synoptic States" was forced to acknowledge that these results "reduce the importance of the role of various types of synoptic situations in the formation of various anomalies."

The examples cited richly illustrate the value of the method of classification and selection of analogs proposed by the author. It is not difficult to imagine what kind of forecast of the coming season (July-August) could be drawn up if it must contain only that which is common for an extremely dry and extremely cold season.

What is at the root of such flagrant contradictions? In our belief, it is the extraordinary worship of both the synoptic catalog and the possibilities of using it. The percents obtained by Vitel's as a result of classification and "catalogization" are nothing but arithmetic fiction. Since the synoptic catalog of the author reflects only the qualitative characteristics of the static state or a poor photograph of the synoptic map, and in no way reflects the dynamic nature of synoptic processes, it leads to a mechanistic interpretation of natural processes.

That is just why the author attempts to prove the possibility of forecasting only average characteristics which are close to norms, which is a return to an epoch long past.

That is why we must conclude that not only the method of group characteristics of analogs, but also the direction selected by the author will never produce positive results.

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